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Managements of Onion Thrips, Thrips tabaci L. (Tysanoptera: Thripidae) to Enhance Bulb Yield of Onion in Toke Kutaye District, Ethiopia

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ABSTRACT

Onion thrips, Thrips tabaci (Thysanoptera: Thripidae), is the most common pest of onion crops, causing farmers significant losses, and its control has been a key challenge in pest management efforts. The objective of this study was to integrate the management of onion thrips to enhance bulb yield of onion and assess various synthetic chemical pesticides to control onion thrips in the laboratory and farmer's field during 2022/2023 at Guder area Toke Kutaye District in the main cropping seasons. In the present study, the laboratory result revealed that Heroplus120% SC, Rapid 72% EC, and Heroplus 120 %SC+ Lemon Soap detergent (LSD) were not significantly different from the standard check (Perfecto 175 % SC). The field study showed that Rapid 72% EC+ LSD and Rapid 72% EC were the maximum mortality followed by LSD + plus Cultural whereas Cultural control methods gave the minimum mortality. The study found that the pesticides mentioned above were quite efficient in reducing onion thrips, it should be recommended to the farmer community for using IPM, which showed the best performance in onion thrips management and gave high net benefit. population, as were insecticide combinations. Therefore, Rapid 72 EC with LSD, Rapid 72 EC alone, and Lemon Soap detergent with cultural control methods are efficient for onion crop producers to control onion thrips and increase yields.

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Introduction

Onion (Allium cepa Linnaeus) belongs to the Alliaceae family and it is the most important bulb crop and widely grown herbaceous biennial vegetable crop [1,2]. Its consumption has been increasingly significant in the world partly because of the health benefits they possess [3]. The bulb, which is made up of the fleshy sheath on the stem plate, is the primary edible part of an onion. According to, onion bulbs are a rich source of calcium, phosphorus, protein, and vitamin C. Its flavor, which improves food's taste, is its most significant quality [4].

In Ethiopia, it is an important vegetable that is produced across a wide range of agro-ecology and it is one of the oldest known bulbous crops and it has a great potential to produce various vegetable crops including onion throughout the year for both local consumption and export with an average yield of 8 tons per hectare [5,6]. As an indirect pest of onion, onion thrips have been associated with an array of viral, bacterial, and fungal plant pathogens [7]. Onion thrips is the principal vector of the economically significant Tospovirus, Iris yellow spot virus (IYSV) (genus Tospovirus, family Bunyaviridae), which reduces the size and quality of bulbs [8]. Currently, growers manage thrips by applying insecticides several times in the growing season. Chemicals are the most common practices for onion thrips management. it is an important insect pest that affects onion yield by direct feeding as well as reducing the quality and quantity by rasping the leaves and other tissues of onion crops to release the nutrients.

Yield losses due to Onion thrips in Toke Kutaye district, West Shoa, Ethiopia, as a result of ranged from 0 to 36.44% [9]. These low-yield results point to a significant gap in the integrated management of onion thrips as well as a lack of knowledge about the advantages of newly developed synthetic pesticides and integrated pest management. To reduce the above drawbacks of insecticides, the use of environmentally friendly integrated onion thrips pest management (IPM) is the most recommended. Currently, the farmers living in the study area are growing Adama red, and Bombay red varieties with some synthetic insecticides rather than using integrated to control the thrips in their fields. They have not known much more information about the integrated management of onion thrips in the study area. Therefore, it is crucial to use integrated pest management for onion thrips.

Materials and Methods

Description of the Experimental Sites

The experiment was conducted under rain-fed conditions at the locations of Guder area in Toke Kutaye districts of West Shewa Zone, Oromia, Ethiopia during the main cropping season of 2021/22. Toke Kutaye was located at 126km West of Addis Ababa, with an altitude of 1990 meters above sea level, a latitude of 08° 59' 01.1' North, and a longitude of 37° 46' 27.6' East. The average annual rainfall is 1028.7 mm and the maximum and minimum temperatures of the area 29.6°C and 11.8°C, respectively.

Preparation of Concentrations

The requir volume of each insecticide was obtained by putting the required quantity of formulation in the beaker and adding water to make volume 1liter. This procedure was repeated for

all insecticides to make the concentration of all insecticides. The different amounts of insecticides were prepared by selecting one insecticide as standard and mixing it with the other insecticide in 1:1 [10].

Laboratory Procedures

The infested onion plants were collected from the unsprayed field for laboratory bioassay and brought to the plant science laboratory, college of Agriculture, Guder Mamo Mezemir Campus, Ambo University of Ethiopia. The experiment was conducted for five days under laboratory conditions at room temperature of 22 - 25°C. 50 nymphs and adults were inserted in an open jar with having 10 cm diameter within the whole plant and provided with coated cotton moist that is kept as fresh leaves of onion that were collected from the field. Chemical insecticides were prepared in according to company recommendations dosses were sprayed in each jar using a micropipette. After 1, 3, and 5 days of exposure, the mortality rates were counted. The bioassay studies were conducted based on the procedure described by with some modifications [11].

Table 1: List of Laboratory Treatments

S/N	Trade name	Common name	Application Rate/ha
1	Heroplus120% SC	Chlorfenaplr + Emamectin benzoate	0.3L
2	Rapid 72% EC (T2)	Profenofos 72% EC	0.7L
3	Lemon Soap Detergent (LSD)	….	5.0L
4	Heroplus 120 %SC+ LSD	….	0.8L + 0.6 L
5	Rapid 72% EC + LSD	….	0.42L + 0.6L
6	Perfecto 175 % SC (Standard Check)	Lambda-Cyhalothrin 50 % + Imidacloprid 125 % SC	2.5L
7	Untreated Control	….	….

Field Evaluation

The experiment was conducted on a farmer's field by randomized complete block design (RCBD) with ten treatments in three replications. The plot size was 2 x 3m. The blocks were separated by 1m, whereas plots within a block were 0.5m apart from each other. Onion seedlings "Adama" red were purchased from Gudar local markets. Recommended amounts of fertilizer (200kg/ha DAP & 100kg/ha Urea) were used.

Table 2: List of Field Treatments

S/N	Trade Name	Common Name	Application Rate/ ha
1	Heroplus120% SC (T1)	Chlorfenaplr + Emamectin benzoate	0.3L
2	Rapid 72% EC (T2)	Profenofos 72% EC	0.7L
3	Lemon Soap Detergent (LSD) (T3)	….	5.0L
4	Heroplus 120 %SC+ LSD (T5)	….	0.18L + 0. 6L
5	Cultural (Removal of thrips manually)	….	….
6	Rapid 72% EC + LSD (T6)	….	0.42 + 0.6L
7	LSD + plus Cultural (T7)	….	0.6 L LSD
8	Heroplus 120 %SC + Cultural + LSD (T8)	….	0.18L + 0.6L LSD
9	Perfecto 175 % SC (Standard Check) (T9)	Lambda-Cyhalothrin 50 % + Imidacloprid 125 % SC	2.5L
10	Untreated Control (T10)	….	….

Note: LSD= Lemon Soap Detergent

Data Collection

Pre-count was recorded from the middle rows every week until the pest reached the economic threshold level of 5 to 10 thrips per plant before treatment application [10]. After the application of insecticides, the number of thrips was recorded at 1, 3, 5, and 7 days intervals. Before using insecticides, the number of onion thrips was recorded at regular intervals by selecting five onion plants from each sampling unit. The post-spray data were recorded at 1, 3, 5, and 7 days of live onion thrips by using hand lenses. The efficacy of the treatments was calculated using the following formula described by [12]. Efficacy analysis is based on data transformation to Arcsine when necessary according to Gomez and Gomez [13].

$$\text{Efficacy} = \frac{\text{Pre spray count} - \text{Post spray count}}{\text{Pre spray count}} \times 100$$

Statistical Data Analysis

The mean data were analyzed with one-way analysis of variance (ANOVA) using Statistical Analysis Software (SAS) and the means were compared with the least significant difference (LSD) for significant differences between the variables [14].

Result and Discussions

Laboratory Evaluation

The laboratory evaluation revealed that Rapid 72% EC (100); Heroplus120% SC (100), LSD (80.0), Heroplus120% SC with LSD (92.5), Rapid 72% EC with LSD (95.0) Perfecto 175 %SC (90.0) percent mortality on onion thrips. The results were a significant ($P \leq 0.05$) difference among the treatments. The toxicity level of Rapid 72% EC and Heroplus 120% SC caused the highest adult and nymph mortality in the laboratory within 3 to 5th days followed by Heroplus 120 %SC + LSD and Rapid 72% EC+ LSD. The lowest mortality was recorded by LSD alone. The result revealed that the percent mortality of Rapid 72% EC + LSD and Rapid 72% EC + LSD was no significant ($P \geq 0.05$) difference.

Table 3: Efficacy of Treatments Against Onion Thrips, Thrips tabaci in Onion Under Laboratory conditions

Treatments	Percent Mortality (%)		
	Day 1	Day 3	Day 5
Heroplus120% SC	20.0^{c}	875^{ab}	100.0^{a}
Rapid 72% EC (T2)	32.5^{b}	92.0^{ab}	100.0^{a}
Lemon Soap Detergent (LSD)	12.5^{c}	80.0^{b}	80.0^{b}
Heroplus 120 %SC+ LSD	35.0^{ab}	92.50^{ab}	92.50^{a}
Rapid 72% EC + LSD (T5)	45.0^{a}	95.0^{a}	95.0^{a}
Perfecto 175 %SC (Standard Check)	35.0^{ab}	90.0^{ab}	90.0^{a}
Untreated Control	00.0^{c}	10.0^{c}	10.0^{c}
LSD at 0.5	10.64	10.8	14.62
MSE±	4.63	4.50	6.36
CV (%)	17.05	21.81	8.17

Note: Means with the same letter(s) in the same columns are not significantly different for each other. All treatment effects were significant at P<0.05 (LSD).

Field Evaluation

Evaluation of different treatments shown after 1st, 3rd, 5th, and 7th days of spray, in the case of the treatments Rapid 72% EC and LSD, when applied combined it gave higher mortality than the other application (Tables 4). The descending order for the percent mortality of different treatments in causing mortality was Rapid 72% EC with LSD (100) > Rapid 72% EC alone (97.1) > LSD+ cultural control (89.62) > Heroplus120% SC alone (87.2 > Heroplus120% SC + LSD (86.78) > Prefecto 175 %SC alone (85.59) > LSD alone (81.77) > Heroplus120% SC + cultural + LSD > Cultural(80.41) against onion thrips. However, all the insecticides combined showed significant (P≤0.05) differences from the untreated check.

The results of the experiments showed that the integration of insecticides reduced the infestation of onion thrips and increased the yield of onions by competing with untreated control. Similarly, reported that IPM-effective tools are used to control onion thrips [15]. Several researchers have reported that onion thrips can bring 36% -37% yield loss if it is left to uncontrol [9,16]. This indicates that this insect can highly damage the crop yield [17]. tested that, using Lamda-cyhalothrin insecticide to control onion thrips can increase onion yield. Similarly, the present investigation. In contrast to this reported that the plot treated by Lamda-cyhalothrin manifested low yield potential [15]. It could be due to the resistance development of onion thrips.

Table 4: Mean Efficacy of Treatments Against Onion Thrips, Thrips tabaci in Onion on Field Conditions

Treatments	Percent Mortality (%)			
	Day 1	Day 3	Day 5	Day 7
Heroplus120% SC	26.84^{ab}	76.92^{bcd}	82.91^{cd}	87.25^{bc}
Rapid 72% EC (T2)	32.85^{ab}	93.55^{a}	97.1^{a}	97.1^{ab}
Lemon Soap Detergent (LSD)	11.96^{ab}	63.67^{de}	76.41^{d}	81.77^{bc}
Cultural (Removal of thrips manually)	41.34^{a}	51.68^{e}	52.78^{e}	41.97^{d}
Heroplus 120 %SC+ LSD	23.54^{ab}	85.97^{abc}	86.78^{bc}	86.78^{bc}
Rapid 72% EC + LSD	32.99^{ab}	92.59^{ab}	100.0^{a}	100.0^{a}
LSD + plus Cultural (T7)	6.39^{ab}	90.41^{abc}	82.83^{cd}	89.62^{abc}
Heroplus 120 %SC + Cultural + LSD	14.55^{ab}	74.86^{cd}	84.12^{cd}	80.42^{c}
Prefecto 175 %SC (Standard Check))	33.82^{ab}	89.43^{abc}	94.56^{ab}	85.59^{bc}
Untreated Control (T10)	0.0^{b}	0.0^{f}	0.0^{f}	10.0^{e}
LSD at 0.5	5.07	2.26	1.44	12.16
MSE±	19.14	8.53	5.44	8.15
CV (%)	18.36	11.87	7.18	20.72

Note: Means with the same letter(s) in the same columns are not significantly different for each other. All treatment effects were significant at P<0.05 (LSD).

Effect of Treatments on Bulb Yield and Yield Components

The result showed that all parameters were found to be statistically no significant (P ≥ 0.05) differences were observed among the treatments (Table 5). The low yield was recorded from untreated control treatment (Table 5) high yields were performed Cultural + Lemon soap Detergent (3692.37kg/ha), Rapid 72% EC + Lemon soap Detergent (3618.57kg/ha), Rapid 72% EC alone (3607.13kg/

ha), and Heroplus 120 %SC + Cultural + Lemon soap Detergent (3566.52kg/ha) were recorded. The lowest bulb yield was found to be in untreated control (2521.22kg/ha). The average yield loss due to onion thrips recorded 2-31.72%durin the study period in Toke kutaye areas of West Shoa, Oromia, Ethiopia [18].

Table 5: Effect of Treatments on Yield and Yield Components of Onion

Treatments	Mean bulb length in (cm)	Mean bulb diameter (cm)	Marketable yield (kg/ha)
Heroplus120% SC	43.54[a]	3.40	3408.25[b]
Rapid 72% EC	37.11[a]	3.66	3607.13[a]
Lemon Soap Detergent (LSD)	33.57[b]	3.31	3120.15[c]
Cultural (Removal of thrips manually)	33.45[b]	3.25	3088.16[c]
Heroplus 120 %SC+ LSD	34.36[b]	3.31	3415.01[b]
Rapid 72% EC + LSD	37.11[a]	3.66	3618.57[a]
LSD + plus Cultural	37.11[a]	3.65	3692.37[a]
Heroplus 120 %SC + Cultural + LSD	35.23[b]	3.12	3566.52[a]
Prefecto 175 %SC (Standard Check)	35.23[b]	3.10	3568.13[a]
Untreated Control	22.68[c]	2.100	2521.22[d]
LSD at 0.5	6.52	Ns	130.21
MSE±	1.33		12.31
CV (%)	15.67		17.72

Note: Means with the same letter(s) in the same columns are not significantly different for each other. All treatment effects were significant at P<0.05 (LSD).

Ns: No Significant Differences

Conclusion

In conclusion, the current study provides basic information for further research and development efforts in newly registered synthetic chemicals in the IPM strategy for the management of onion thrips in the study area.

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